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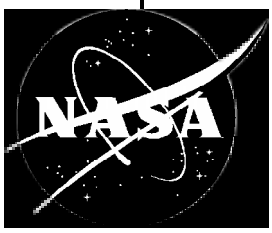
Interface Control Document (ICD) Between the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) and EOSDIS Operations Center (EOC)

September 1997



National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Interface Control Document (ICD) Between the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) and EOSDIS Operations Center (EOC)

September 1997

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Preface

This document is under the configuration management of the National Aeronautics and Space Administration (NASA) Communications (Nascom) Division Configuration Control Board (CCB).

Proposed changes to this document shall be submitted to the Nascom CCB, along with supportive material justifying the change. Changes to this document shall be made by Document Change Notice (DCN) or by complete revision.

Questions concerning this document and proposed changes shall be addressed to:

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Abstract

This Interface Control Document (ICD) describes interface agreements between the Earth Observing System (EOS) Data and Information System (EOSDIS) Operations Center (EOC) and EOSDIS Backbone Network (EBnet).

Keywords: *EBnet, EOC, EOSDIS, ICD, Interface Control Document*

Change Information Page

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Signature Page	DCN 001
iii, v, viii	DCN 001
1-1 and 1-2	DCN 001
2-1 and 2-2	DCN 001
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Abbreviations and Acronyms

Section 1. Introduction

1.1 Authority and Responsibility

The Mission Operations and Data Systems Directorate (MO&DSD) has the authority to implement Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet). This authority was granted to the MO&DSD by the EOS project, under the Office of Mission to Planet Earth (Code Y). The EBnet project is under the National Aeronautics and Space Administration (NASA) Communications (Nascom) Division of the MO&DSD.

Code 540 will provide an operational communications network to support high-speed network communications between EBnet and non-EBnet hosts. The primary responsibility for this project has been assigned to the Nascom Division, Code 540. The system requirements are documented by the references in Section 2.1.

1.2 Purpose

The purpose of this document is to provide a detailed definition of the interface(s) between the EBnet and the EOSDIS Operations Center (EOC).

1.3 Scope

This Interface Control Document (ICD) defines and controls the functions, communications protocol(s), frame formats, and electrical characteristics of the interfaces between EBnet-provided equipment, software, and communications paths and other entities that directly interface with the network. Interfaces provided by Nascom are included in the scope of this document. Interfaces between EBnet users and other systems not provided by Nascom are not within the scope of this document.

1.4 Time Frame

This ICD shall be in effect from the date of the last approval signature.

1.5 Goals and Objectives

The goals of EBnet are to:

a. Implement an operational, integrated, transparent communications system that serves the data communications needs of projects supported by NASA Goddard Space Flight Center (GSFC), and users outside the MO&DSD.

b. Expand using industry standard system solutions while maintaining compatibility with the existing network and user interfaces.

c. Minimize costs for implementation, operation, and maintenance of the network.

d. Minimize life-cycle costs.

e. Maintain high availability by designing with redundancy, and without single points of failure in the Network Backbone, where required.

f. Utilize state-of-the-art technology, utilizing equipment with the best price-performance available commercially.

g. Allow for growth, adaptability to changing requirements, infusion of new technology, and upgraded interfaces throughout the life-cycle.

1.6 Standards Precedence

EBnet will be based on Government, commercial, and international standards. In case of conflict, the following precedence (in descending order) applies:

- This EBnet ICD.
- Government standards.
- Commercial and/or international standards.

1.7 Document Organization

Section 2 contains parent, applicable, and reference documents related to this ICD.

Section 3 details a systems overview of the EBnet, the EOC, and the interrelationship.

Section 4 describes the EBnet system architecture and identifies the standards supported at each level of the International Organization for Standardization (ISO) model.

Section 5 describes the facilities and maintenance demarcation.

A list of abbreviations and acronyms is provided at the end of the document.

Section 2. Related Documentation

2.1 Parent Documents

[1] *Earth Observing System AM-1 Detailed Mission Requirements*, Goddard Space Flight Center (GSFC), 505-10-33, November 1996

[2] *Earth Science Data Information System (ESDIS) Project Level 2 Requirements Volume 6, EOSDIS Backbone Network (EBnet) Requirements*, Goddard Space Flight Center (GSFC) 505-10-01-6, Revision A, December 1996

[3] *Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Interface Requirements Document (IRD)*, September 1997

[4] Reserved

2.2 Applicable Documents

[5] *Electrical Characteristics of Balanced Voltage Digital Interface Circuits*, Electronic Industries Association (EIA) 422-A, December 1978

[6] *General-Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, EIA 449, November 1977

[7] *Internet Protocol (IP): DARPA Internet Program Protocol Specification*, Request for Comment (RFC) 791, September 1981

[8] *The Point-to-Point Protocol (PPP)*, RFC 1661, July 1995

[9] *An Ethernet Address Resolution Protocol or Converting Network Protocol Addresses to 48-bit Ethernet Addresses for Transmission on Ethernet Hardware*, RFC 826, November 1982

[10] *Internet Control Message Protocol*, RFC 792, September 1981

[11] *Routing Information Protocol (RIP)*, RFC 1058

[12] *Open Shortest Path First (OSPF)*, RFC 1247

[13] *Internet Group Multicast Protocol (IGMP)*, RFC 1112

[14] *On the Assignment of Subnet Numbers*, RFC 1219

[15] *Simple Network Management Protocol (SNMP)*, RFC 1157

[16] Reserved

[17] *A Reverse Address Resolution Protocol (RARP)*, RFC 903

[18] *Internet Protocol on Ethernet Networks*, RFC 894

[19] *Transmission of IP over FDDI*, RFC 1188

[20] *Structure of Management Information*, RFC 1155

[21] *Management Information Base - II*, RFC 1213

[22] *Transmission Control Protocol*, RFC 793

[23] *Telnet Protocol*, RFCs 854 & 855

[24] *File Transfer Protocol*, RFC 959

[25] International Organization for Standardization (ISO) 9314-1, *FDDI Physical Layer Protocol (PHY)*

[26] ISO 9314-2, *FDDI Media Access Control (MAC) Protocol*

[27] ISO 9314-3, *FDDI Physical Layer Medium Dependent (PMD)*

[28] ISO 8802-2, *Logical Link Control (LLC)*

[29] ISO 8802-3, *Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) Media Access Control (MAC) - Ethernet version 2*

[30] Institute of Electrical and Electronic Engineers (IEEE) 802.3 *10Base-T (twisted pair)*

[31] IEEE *10Base5 (thick ethernet)*

[32] International Telegraph and Telephone Consultative Committee (CCITT) *V.35*

2.3 Reference Documents

[33] *NASA Communications (Nascom) Access Protection Policy and Guidelines*, 541-107, Revision 3, GSFC, November 1995

[34] *NASA Communications System Acquisition and Management*, NASA Management Instruction (NMI) 2520.1D, National Aeronautics and Space Administration (NASA), November 18, 1991

[35] *Nascom IONET Users Guide*, 541-225, Revision 1, April 1996

Section 3. Systems Overview

3.1 EBnet General System Description

The EBnet provides wide-area communications circuits and facilities between and among various EOS Ground System (EGS) elements to support mission operations and to transport mission data between EOSDIS elements. The relationship of EBnet to other elements supporting EOS is shown in Figure 3-1. EBnet is responsible for transporting spacecraft command, control, and science data nationwide on a continuous basis, 24 hours a day, 7 days a week. The EBnet capability to transport these diverse types of data is implemented as two distinct subnetworks referred to as "real-time" and "science" networks. The real-time network transports mission-critical data related to the health and safety of on-orbit space systems and raw science telemetry as well as pre-launch testing and launch support. This highly redundant network provides an operational availability of 0.9998 with a Mean Time to Restore Service (MTTRS) of 1 minute. The science network transports data collected from spacecraft instruments and various levels of processed science data including expedited data sets, production data sets, and rate-buffered science data. The science network provides an operational availability of 0.98 with a MTTRS of 4 hours.

EBnet provides three options for accessing the Internet Protocol (IP)-based EBnet transport service: Local Area Network (LAN) Ethernet, LAN Fiber Distributed Data Interface (FDDI), and Wide Area Network (WAN) carrier service. Figure 3-2 shows an example of each of these types of interface/demarcation points to EBnet users. This ICD describes the EBnet/EOC interface which uses the WAN and/or LAN interface types.

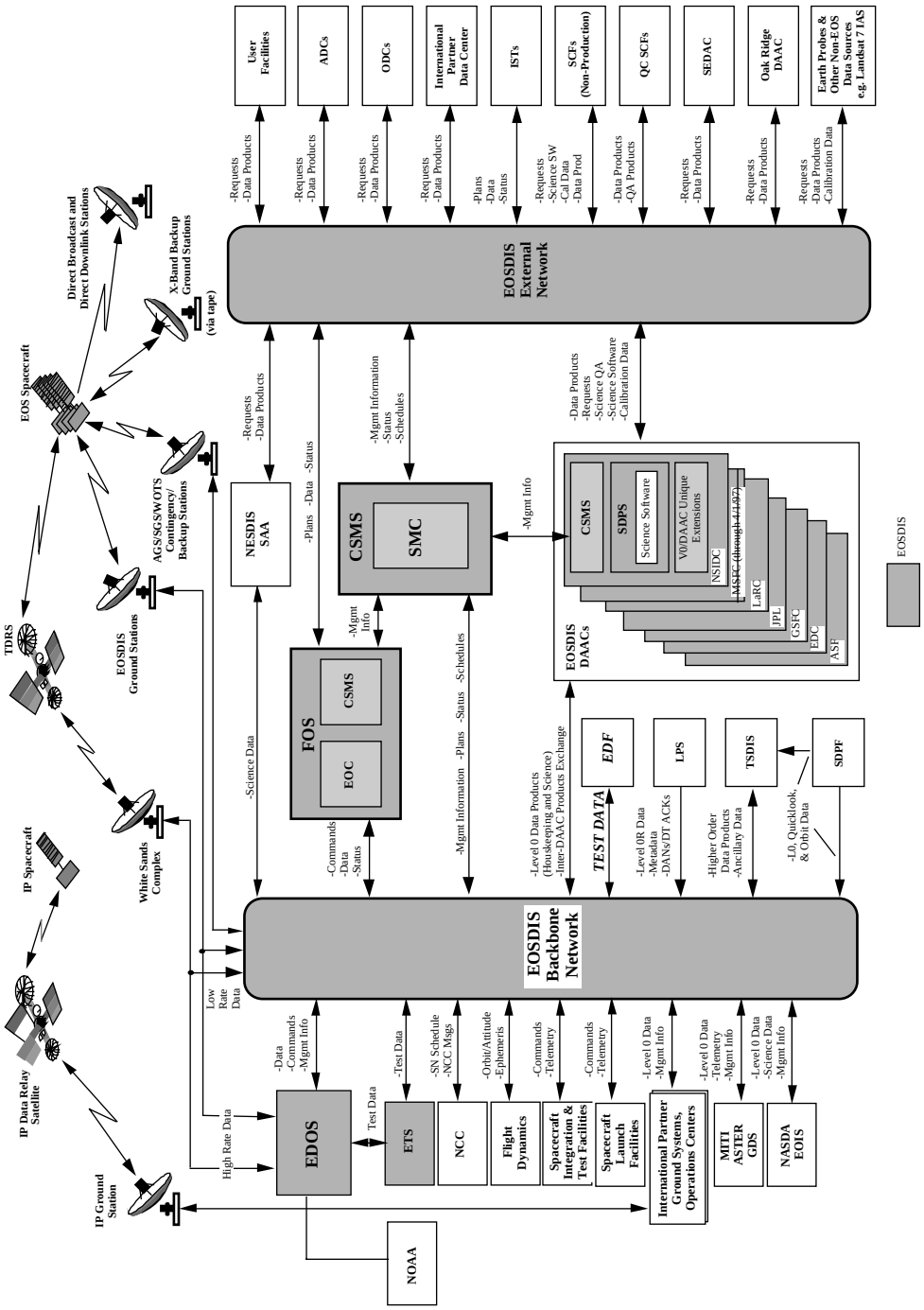

Figure 3-1. EOS Ground System

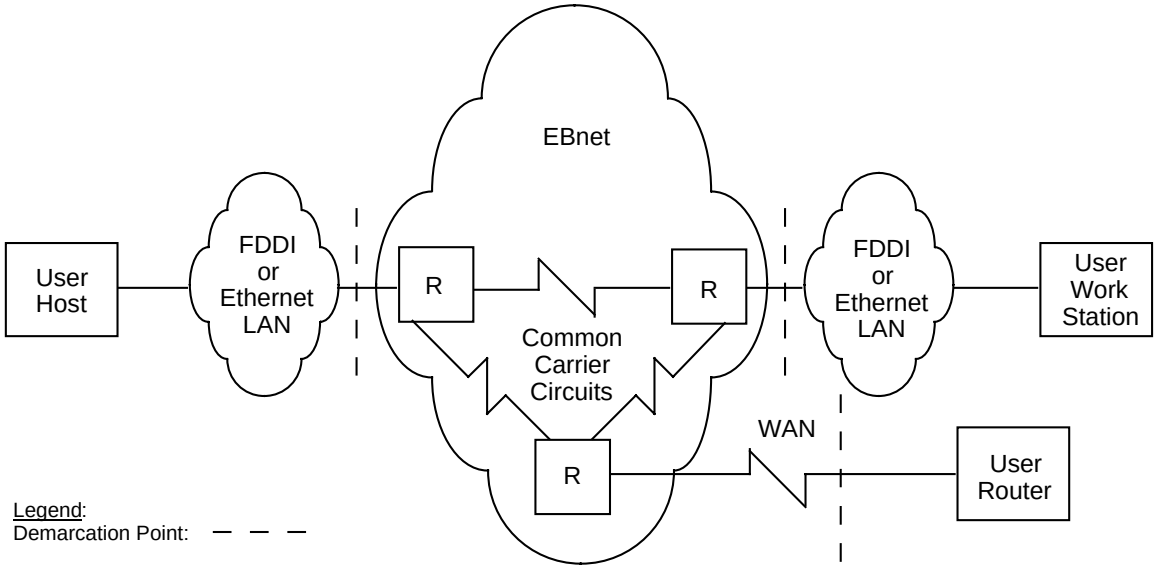

Figure 3-2. EBnet Demarcations

Sustaining engineering, preventive and remedial maintenance, and network monitoring services are provided for EBnet equipment, to ensure that EBnet keeps pace with technology and standards, and provides continuous service. The official point of contact for EBnet operational status is the Nascom Communications Manager (COMMGR) (301-286-6141). Users who detect a network problem are urged to immediately report it to the COMMGR. The COMMGR may also provide users with limited information about maintenance and status actions. Refer to the Nascom IP Operational Network (IONET) User Guide (541-225) for information regarding user connections, security guidelines, and maintenance information.

3.2 EOC Description

The EOC architecture will be as shown in Figure 3-3. The critical real-time information flow between EOS Data and Operations System (EDOS) and the EOC will flow through the operational FDDI ring. The support FDDI ring will be used for testing and training. The EOC facility houses the Flight Operations System (FOS), workstations from Flight Dynamics Facility (FDF), and various workstations performing simulation and analysis.

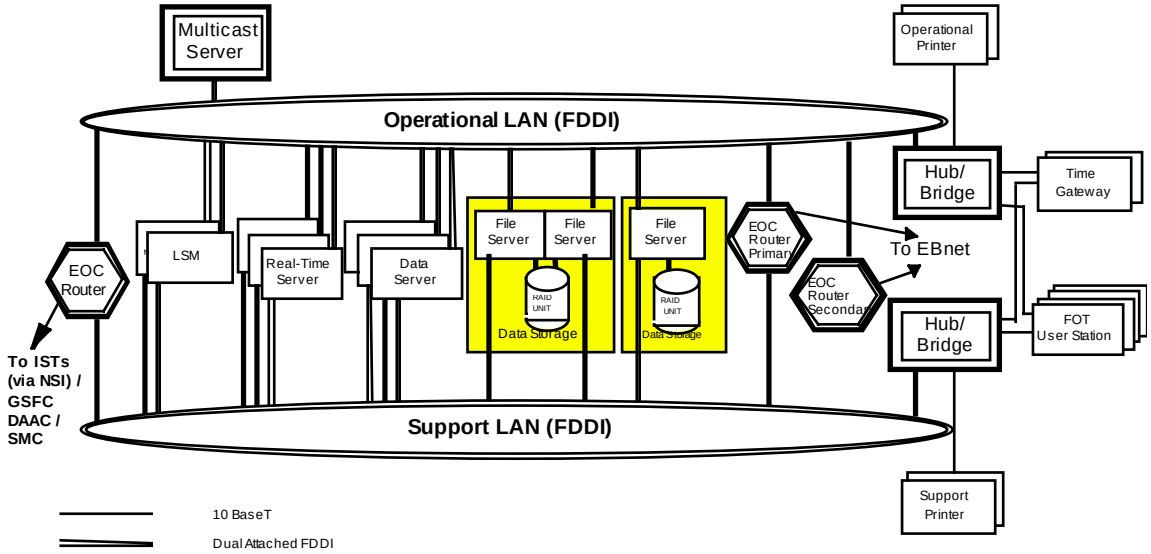

Figure 3-3. EOC LAN Design

3.3 Relationship between EOC and EBnet

EBnet will support all EOC external interfaces (i.e., all interfaces to non-EOSDIS Core System (ECS) entities).

The external EOC interfaces supported by EBnet are shown in Figure 3-4. The shaded portions of the drawing are considered to be part of the FOS. This includes the Instrument Operations Team (IOT) workstations in remote locations that use the Instrument Support Terminal (IST) software toolkit. EBnet will not support interfaces to the IOT workstations (shaded). However, EBnet will support several external EOC interfaces that use the IST software toolkit, for example, the Software Development Facility at Valley Forge, Pennsylvania and the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Operations Segment in Japan.

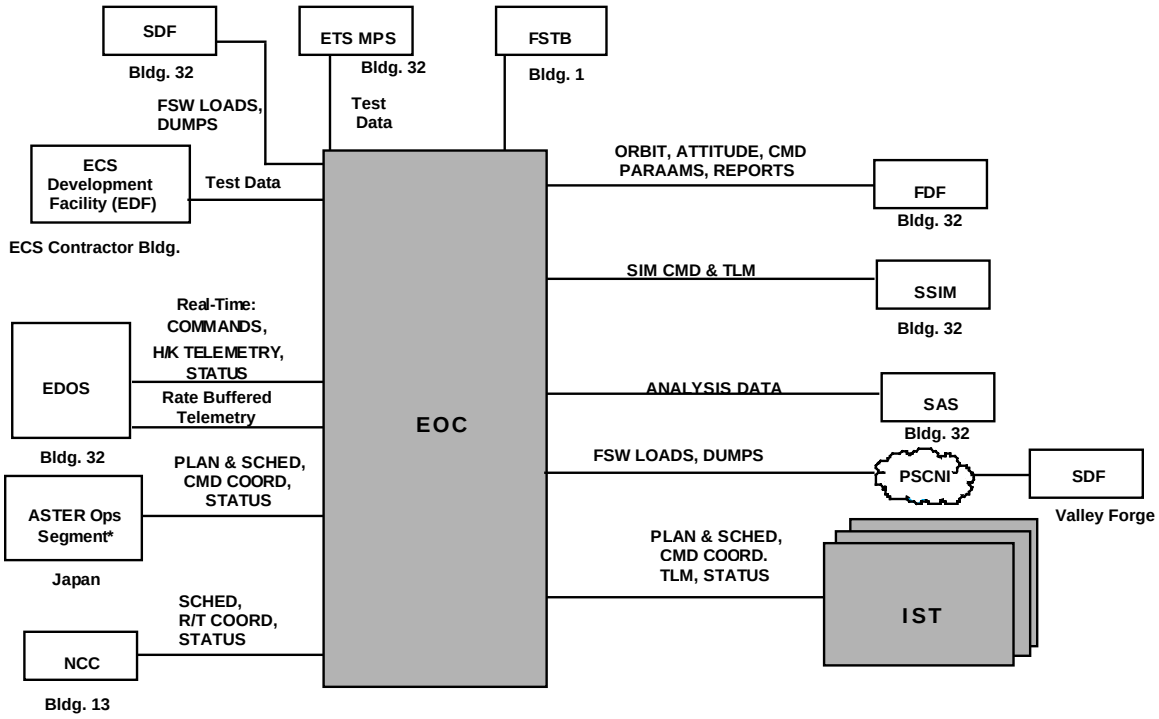

Figure 3-4. EOC Interfaces

Section 4. Interface Detailed Design

4.1 Interface Design Overview

The EBnet presence in Building 32 at GSFC will support EOC interfaces as shown in Figure 4-1. Use of FDDI switching will provide the high-speed connectivity required by the various EOC interfaces.

4.2 Design Assumptions

Real-time data will be supported separately from science data. Redundant routers will be provided for real-time data flows. Separate serial streams will be provided for real-time WAN applications, if deemed necessary by the EBnet project manager.

EBnet will provide network management using Simple Network Management Protocol (SNMP), including monitoring and control, for all EBnet-provided equipment (routers, concentrators, etc.). Reference the EBnet to Systems Monitoring and Coordination Center ICD (540-036) for further information.

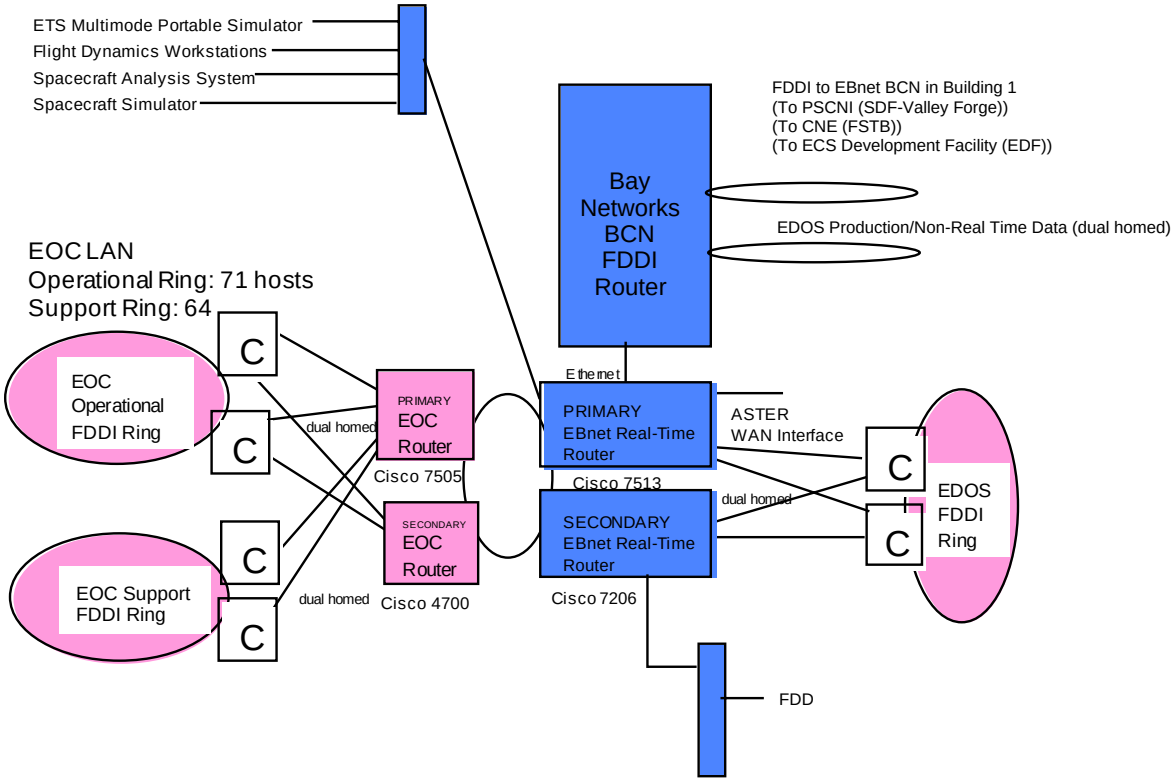

Figure 4-1. EBnet Connections to Support the EOC

EBnet routers will provide filters to support security on a subnet basis. No service or port level filters will be supported.

4.3 Overview of System Interfaces

The following sections detail the standards that will be supported at each level of the ISO seven-layer model.

4.3.1 ISO Layer One Interface Control (Physical Layer)

EBnet will support the following physical layer connections from equipment located within the EOC:

a. Institute of Electrical and Electronic Engineers (IEEE) 802.3, 10BaseT (unshielded twisted pair) with RJ45 connectors.

b. ISO 9314-1, FDDI Physical Layer Protocol (PHY).

c. ISO 9314-3, FDDI Physical Layer Medium Dependent (PMD).

4.3.2 ISO Layer Two Interface Control (Data Link Layer)

EBnet will support the following data link layer protocols:

a. ISO 802.2, Logical Link Control (LLC).

b. ISO 8802-3, Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) Media Access Control (MAC) - Ethernet Version 2.0 is supported.

c. ISO 9314-2, FDDI Media Access Control (MAC) Protocol.

4.3.3 ISO Layer Three Interface Control (Network Layer)

EBnet will support the following network layer protocols from Distributed Active Archive Center (DAAC) sites:

a. RFC 791, Internet Protocol Version 4.0.

b. RFC 826, Address Resolution Protocol (ARP).

c. RFC 903, Reverse Address Resolution Protocol (RARP).

d. RFC 1058, Routing Information Protocol (RIP).

4.3.4 ISO Layer Four Interface Control (Transport Layer)

EBnet will support transparent communication at the transport layer.

4.3.5 ISO Layer Five Interface Control (Session Layer)

EBnet will support transparent communication at the session layer.

4.3.6 ISO Layer Six Interface Control (Presentation Layer)

EBnet will support transparent communication at the presentation layer.

4.3.7 ISO Layer Seven Interface Control (Application Layer)

EBnet will support transparent communication at the application layer.

4.3.8 Network/Station Management Protocols

EBnet shall support, at a minimum, the following management protocols:

a. SNMP.

b. FDDI Station Management (SMT) 6.2 or higher.

4.4 Routing and Addressing Guidelines

EBnet will be internetworked by routers which will be configured to support only the IP protocol, and will provide isolation for separate networks. Cisco 7500 and 4700 routers have been chosen to provide network access to users.

EBnet will utilize standard IP addressing conventions. EBnet will provide a Class C subnet addresses to each connected site. The subnet addresses assigned to the EOC are 198.118.199.0 and 198.118.200.0. EBnet will not advertise ECS routes to the Internet.

4.5 Data Flow Requirements

The purpose of the interface between the EOC and EBnet is to support connectivity between the EOC and the various internal and external systems (reference Figure 3-3). The EOC flows to EDOS at GSFC and the ASTER Instrument Control Center (ICC) at Tokyo consist of both real-time and non-real-time traffic types. All other EOC flows supported by EBnet are solely non-real-time traffic. Non-real-time traffic is supported through ‘science’ level of service.

Table 4-1 describes the interfaces with systems that exchange data with the EOC. Table 4-2 shows the data flow requirements received from the Earth Science Data and Information System (ESDIS) project, including protocol overhead.

4.6 Equipment List

EBnet will provide the following equipment to support this interface:

a. Router for science data: Bay Networks (Model BCN).

b. Primary Real-time Router: Cisco (Model 7513).

c. Backup Real-time Router: Cisco (Model 4700).

d. Fiberoptic Patch Panel: Siecor (Model C-MIC-012).

e. 24-port Ethernet Hub: Cabletron (Model SEHI-24).

Table 4-1. EOC Interfaces Provided by EBnet Project

EOC Interface to:	EBnet Interface	Performance Requirement	Operational Notes
ASTER Ops Segment	WAN link to Japan	64 kilobits per second (Kbps)	ASTER has an IST interface. Command, scheduling and planning information.
EDOS for Non-RT Data	Local FDDI interface through FDDI router	1.8 megabits per second (Mbps)	EDOS initiates all file transfers for rate-buffered data and Spacecraft Contact Session (SCS) reports. EOC initiates all file transfers for schedules.
EDOS for Real-Time Data	Local FDDI interface through EDOS concentrators	42 Kbps	Need User Datagram Protocol (UDP) multicasting for real time (RT) service: Telemetry and Command, Customer Operations Data Accounting (CODAs.) Maximum load is 6 satellites.
EDOS	Local Ethernet interface through FDDI router	104 Kbps	Need UDP multicasting for RT service: Telemetry and Command, CODAs
ETS Multimode Portable Simulator (MPS) in Bldg 32	Local Ethernet interface through FDDI router	131.25 Kbps	Need UDP multicasting for RT service: Telemetry and Command, CODAs. Rate buffered data also transferred.
Flight Dynamics Division	Local Ethernet interface through FDDI router, one link to each of the four FDD workstations	1.0 Mbps to EOC	File transfers may be initiated by FDD or EOC: RT telemetry and data products. Two FDD workstations have IST interface (only 1 active at a time for RT telemetry)
Flight Software Testbed (FSTB)	Ethernet interface to FDDI router in Bldg 1	131.25 Kbps	EOC initiates all file transfers
interface to ECS Development Facility (EDF), Hughes Bldg. Landover MD	FDDI interface to FDD router in Bldg 1	520 Kbps	EOC initiates test file transfers to the ECS Development Facility (EDF), Hughes Bldg. Landover MD.
Nascom Network Control Center (NCC)	Ethernet interface to Bldg 13	To EOC: 119 Kbps From EOC: 476 Kbps	EOC initiates TCP/IP sessions. Link required late 1996.
Spacecraft Analysis System (SAS)	Local Ethernet interface through Ethernet Hub	1.2 Mbps	EOC initiates all file transfers and X-Windows sessions.
Software Development Facility (SDF) (Valley Forge)	WAN link to Valley Forge through PSCNI	512 Kbps	SDF has an IST interface. Command, scheduling and planning information.
Software Development Facility (SDF) (GSFC)	Local Ethernet interface through FDDI router	1.2 Mbps	SDF has an IST interface. Command, scheduling and planning information.
Spacecraft Simulator (SSIM)	Local Ethernet interface through FDDI router	1200 Kbps	EOC initiates all file transfers (SSIM initialization files) and X-Windows sessions. Also interfaces with ETS LRS. Interface only available in Bldg 32.

Table 4-2. EOC Data Flow Requirements Obtained From the ESDIS Project

Network Interface	Data Type	1/1/97 Rate (Kbps)	8/1/97 Rate (Kbps)	9/1/97 Rate (Kbps)	5/1/98 Rate (Kbps)	7/1/98 Rate (Kbps)	10/98 Rate (Kbps)	1/1/99 Rate (Kbps)	6/1/99 Rate (Kbps)	1/1/2000 Rate (Kbps)
ASTER GDS to EOC	RT	64								
EDOS to EOC	RT	42 (Housekeeping Data) and 104.125 (Operations Management Data)								
	Non-RT	1875								
EOC to EDOS	RT	17.5								
EOC to EDOS	RT	104.125 (Operations Management Data)								
EOC to ETS MPS	RT	131.25								
EOC to FDF (Bldg. 32)	RT	1088								
FDF (Bldg. 32) to EOC	RT	1088								
EOC to NCC	RT	119								
NCC to EOC	RT	476								
FSTB to EOC	RT	131.25								
SAS in EOC to EOC	RT	1200								
SAS in EOC to SDF (GSFC)	RT						1200			
SSIM to EOC	RT		1200							
EOC to EDF	RT				520					
SAS in EOC to SDF (VFPA)	Non-RT				131.125					
EOC to ASTER GDS	RT	64								

Section 5. Facilities and Maintenance Demarcation

5.1 Equipment Location

The EOC will provide two rack spaces for EBnet racks housing the routers and hubs. These locations are shown in Figure 5-1. Uninterruptible power supply (UPS) power and underfloor cooling will be provided by the EOC.

5.2 Maintenance Demarcation

The demarcation point between EBnet maintenance and EOC maintenance is the connection at the EBnet router. Cabling connecting to the EBnet router from EOC-located routers and workstations will be provided and maintained by the EOC. The EOC will provide 24-hour access to EBnet maintenance personnel.

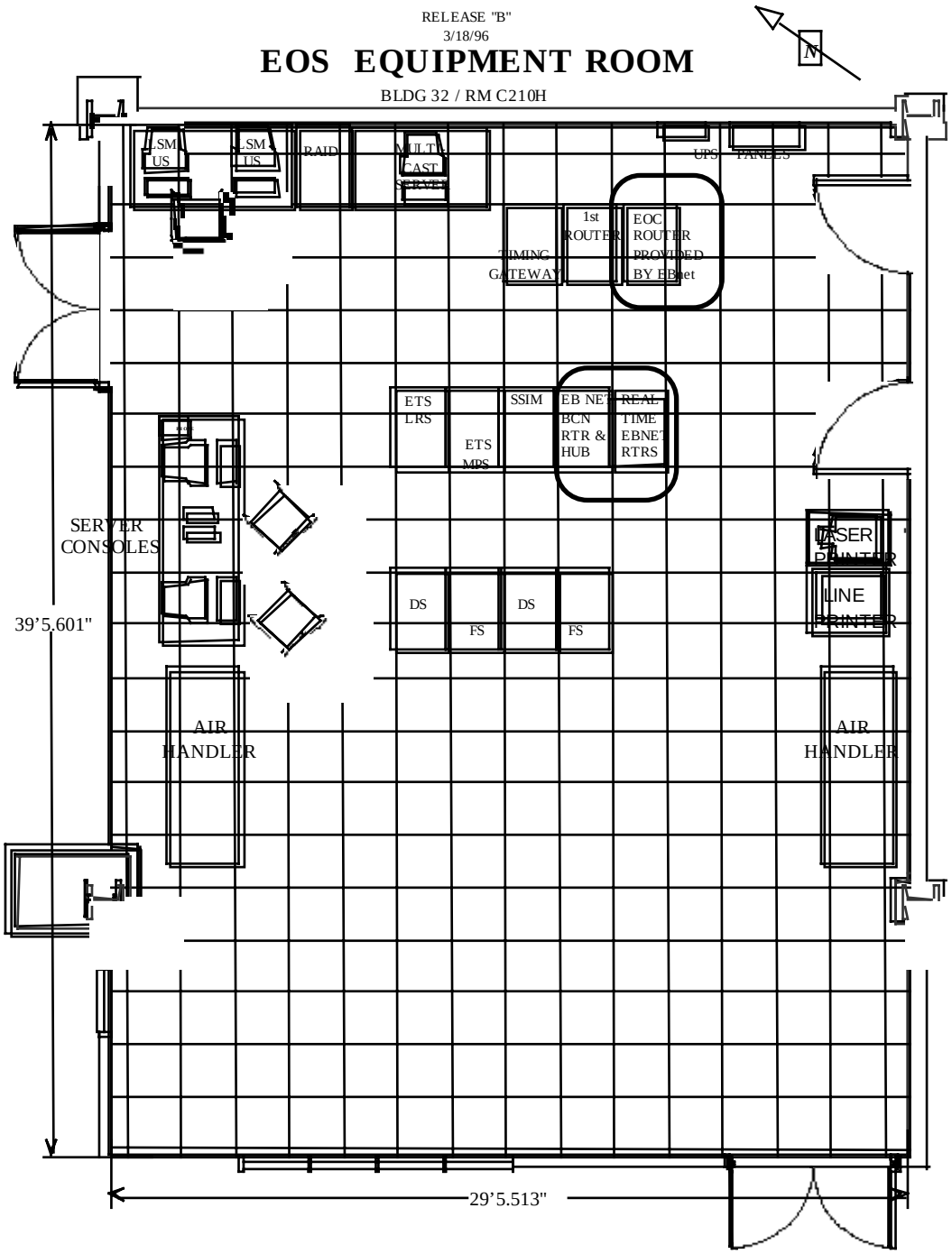

Figure 5-1. EOC Equipment Room Layout

Abbreviations and Acronyms

ARP	Address Resolution Protocol
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
CCB	Configuration Control Board
CCITT	International Telegraph and Telephone Consultative Committee
CODA	Customer Operations Data Accounting
COMMGR	Communications Manager
CSMA/CD	Carrier-Sense Multiple-Access with Collision Detection
CSMS	Communication and System Management Segment
DAAC	Distributed Active Archive Center
DARPA	Defense Advanced Research Projects Agency
DCN	Document Change Notice
EBnet	EOSDIS Backbone Network
ECS	EOSDIS Core System
EDOS	EOS Data and Operations System
EGS	EOS Ground System
EIA	Electronic Industries Association
EOC	EOSDIS Operations Center
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
ESDIS	Earth Science Data and Information System
ETS	EOSDIS Test System
FDD	Flight Dynamics Division
FDDI	Fiber Distributed Data Interface
FDF	Flight Dynamics Facility
GSFC	Goddard Space Flight Center
ICC	Instrument Control Center

ICD	Interface Control Document
IEEE	Institute of Electrical and Electronic Engineers
IGMP	Internet Group Multicast Protocol
IONET	IP Operational Network
IOT	Instrument Operations Team
IP	Internet Protocol
IRD	Interface Requirements Document
ISO	International Organization for Standardization
IST	Instrument Support Terminal
Kbps	kilobits per second
LAN	Local Area Network
LLC	Logical Link Control
LRS	Low Rate System
MAC	Media Access Control
Mbps	megabits per second
mgmt	management
MO&DSD	Mission Operations and Data Systems Directorate
MODNET	MO&DSD Operational/Development Network
MPS	Multimode Portable Simulator
MTTRS	Mean Time to Restore Service
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications
NCC	Network Control Center
NMI	NASA Management Instruction
NOLAN	Nascom Operational Local Area Network
OSPF	Open Shortest Path First
PHY	Physical Layer Protocol
PMD	Physical Layer Medium Dependent
PPP	Point-to-Point Protocol

R/T, RT	real time
RARP	Reverse Address Resolution Protocol
RFC	Request for Comment
RIP	Routing Information Protocol
SAS	Spacecraft Analysis System
SNMP	Simple Network Management Protocol
SSIM	Spacecraft Simulator
UDP	User Datagram Protocol
UPS	uninterruptible power supply
WAN	Wide Area Network